

Rapidity Gap Events in Squark Pair Production

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Outline

1 Introduction

- Squark pair production
- Electroweak contributions
- Rapidity gap events

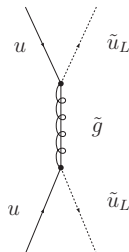
2 Numerical results

- Preliminaries
- Results

3 Summary

Squark pair production at the LHC

- first collisions to be expected in 2009
- even if squarks (first two generations) are among the heaviest particles, they will have very large production cross sections



Squark pair production at the LHC

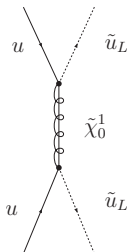
- assume degenerate first and second generation squarks, where $m_{\tilde{q}} \approx 1 \text{ TeV}$
- cross section is about $\sigma \approx 0.5 \text{ pb}$
- assume low luminosity $\mathcal{L} \approx 10 \text{ fb}^{-1}$ per year

$$N_{\text{events}} = \mathcal{L} \sigma$$

- 5000 events are expected per year at low luminosity

Role of electroweak (EW) contributions

- it is important to know the squark pair cross section precisely, since the cross section can be measured with a statistical uncertainty of a few percent
- we included EW corrections at leading order
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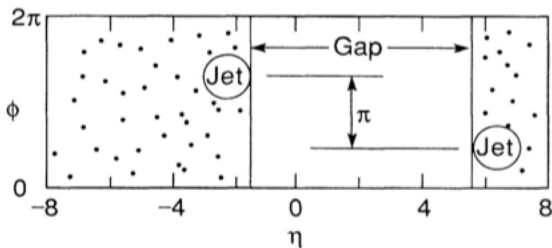
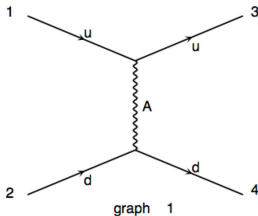
Results from electroweak contributions

- EW corrections due to SU(2) interactions are more important
- contribution with interference between EW t - and QCD u -channel is dominant for SU(2) doublet squarks and vice versa
- EW effects can reduce or enhance the total cross section by more than a factor of 1.5
- for gaugino mass unification (mSUGRA), the enhancement factor is up to 1.3

Rapidity gap

- in EW channels, both initial partons are not color-connected
- if both partons are not color-connected, the phase space between the jets (arising from the partons) and the beam remnants will be filled by gluon radiation
- **large rapidity gap** is a region of rapidity, in which are **no hadrons**
- if both jets are color-connected, the phase space between both jets will be filled by gluons

Single boson exchange



There are no free lunches

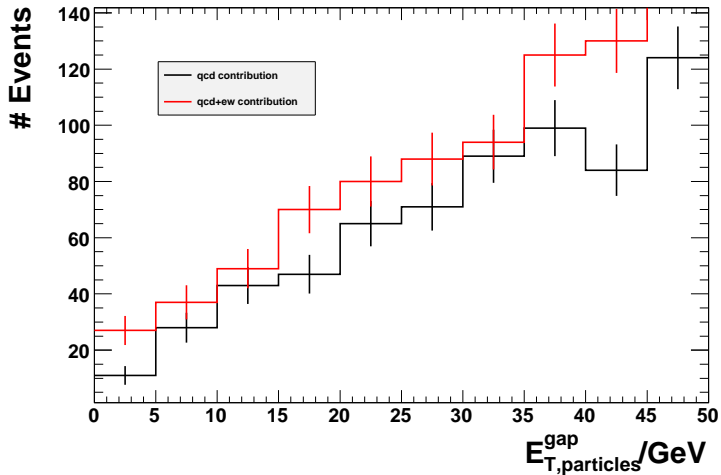
- how big must be the rapidity gap?
- can QCD fake a rapidity gap?
- underlying event
- what's the survival probability of rapidity gaps?

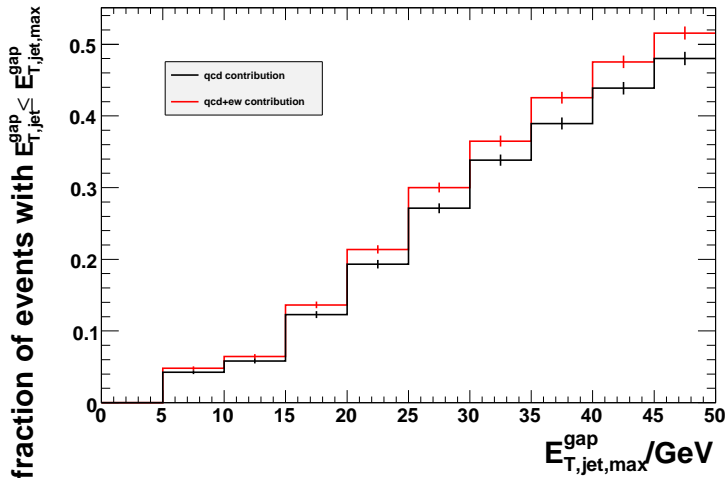
Preliminaries I

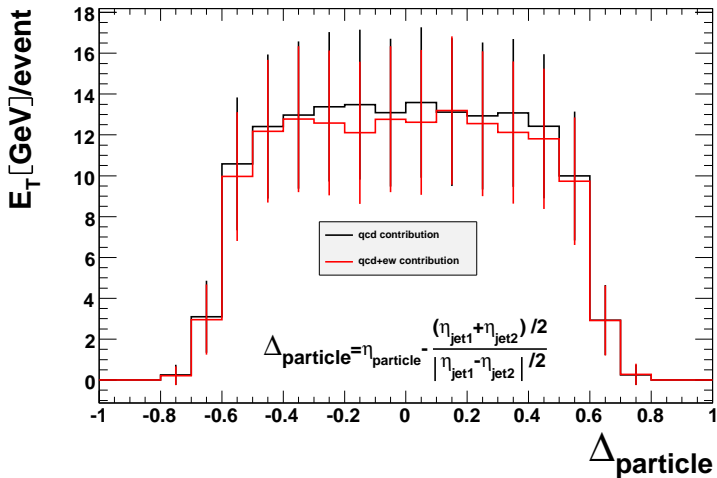
- mSUGRA ($m_0 = 100$ GeV, $m_{1/2} = 250$ GeV, $m_{\tilde{q}} \approx 560$ GeV) mass spectrum is assumed
- cross section for production of two SU(2) doublet squarks is enhanced by a factor of 13% by EW contributions
- SU(2) singlet squark decays into lightest neutralino
- SU(2) doublet squark decays into heavier neutralino/chargino, latter decaying leptonically

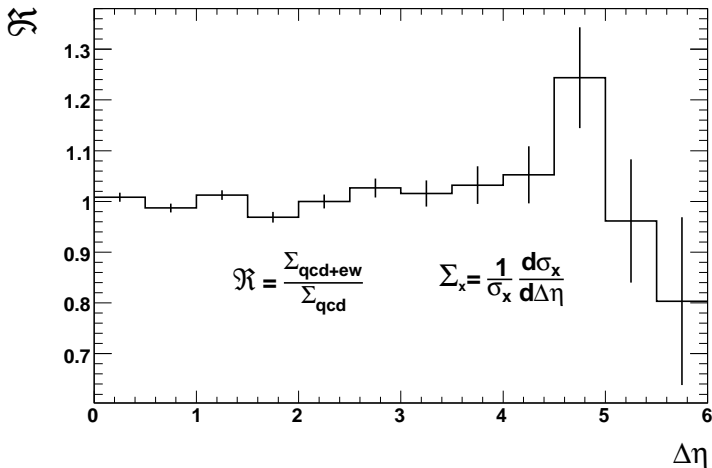
Preliminaries II

- the full events are generated from partonic events by Herwig++
- we generated about 490000 events
- we require a rapidity gap of $\Delta\eta \geq 3.0$ between both jets
- SU(2) doublet squark contribution is enhanced by requiring isolated charged leptons
- we assume tau identification efficiency to be 100%









Summary

- an **independent handle** to search for supersymmetric events
- **information about masses/couplings of charginos/neutralinos can be obtained**, since ratios of couplings can be obtained from branching ratios of squarks
- it will be **difficult**